The carriers' carrier consolidation approach in sustainable urban logistics: Trials, benefits and future growth

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Hypotheses and Lead Questions

• Following hypothesis and questions build the starting point of this study:
  - How to scale-up the use of electric vehicles instead of diesel vans to reduce air pollutants and carbon emissions?
  - Is the carriers’ carrier approach to parcel deliveries business reducing the total freight distance for retail and e-commerce clients, by changing from outer London depots to centrally located logistics distribution centres in London?
  - Is there a difference in consolidating deliveries of carriers and retail clients into one single van delivery trip to reduce the number of vehicle movements, associated congestion and air pollution?
Hypothesis, questions & objectives

• Initial **hypothesis**: The aim of this study was to demonstrate the benefits for public sector and private business, which are occurring when using a carriers’ carrier approach to grow consolidation and electric vehicles in city centers.

• The study assessed the potential for:
  - re-timing of e-commerce B2C activity, away from peak hours
  - re-routing of journeys away from the most congested roads and pollution hot spots
  - improving the logistics efficiency (time and distance per parcel)
  - reduction in emissions (CO$_2$, diesel particulates, NO$_x$)

• **Objective** of this study is to verify/falsify this hypothesis and answer the **question**: what are the benefits for public sector and private business, which are occurring when using a carriers’ carrier approach to grow consolidation and electric vehicles in city centers.
Approach and Methods

- Freight efficiency optimisation
- Climate Change mitigation
- Internalise external costs
- Improve business model
- Minimise risks
- Customer oriented

Conceptual and mathematical framework

Before-after Tests & trials

Impact assessment, data monitoring and reporting

With one Carrier with Carriers with Retailers

Legacy (scale-up) & future scenario

Calculations & validation

Impact assessment, data monitoring and reporting

Conceptual and mathematical models for testing consolidated urban freight deliveries

Theoretical framework

Impact assessment, data monitoring and reporting

Conceptual and mathematical models for testing consolidated urban freight deliveries

Calculations & validation
Selection of businesses

• The London parcels delivery business **Gnewt Cargo** tested electric vehicles and logistics consolidation in Central London during the one-year trials from 1st July 2015 to 30 June 2016.

• The customers were carriers and retailers, paying the same price per parcel than for other subcontractors

• Carriers:
  – Hermes
  – TNT UK
  – DX

• Retailers:
  – Farmdrop (Food e-commerce)
  – Emakers (e-commerce delivery business)
  – Spicers (leading UK wholesale office suppliers)
Central London Delivery Area

Location of Gnewt Cargo urban distribution centers used in 2015-2016

Typical geolocation of 100% electric delivery fleet on an average day
Trial: parcels delivery business
Gnewt Cargo in Central London

A last-mile logistic provider using a 100% ELECTRIC fleet and centrally located urban logistics consolidation centers
Over 100 electric vehicles fleet

Delivered over 2,634,000 items 2016 zero emission

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total parcels delivered</td>
<td>2,005,728</td>
</tr>
<tr>
<td>Average parcels delivered per week</td>
<td>38,572</td>
</tr>
<tr>
<td>Average parcels per van per day</td>
<td>151</td>
</tr>
<tr>
<td>Maximum parcels/van/day</td>
<td>668</td>
</tr>
<tr>
<td>Minimum parcels/van/day</td>
<td>1</td>
</tr>
<tr>
<td>Total miles driven</td>
<td>148,545</td>
</tr>
<tr>
<td>Average miles per van per day</td>
<td>11</td>
</tr>
<tr>
<td>Average metres per parcel</td>
<td>119</td>
</tr>
<tr>
<td>Average completion</td>
<td>87%</td>
</tr>
<tr>
<td>Total driver working time in minutes per parcel</td>
<td>6</td>
</tr>
</tbody>
</table>
Results: Main benefits

- **the carrier’s carrier approach**, by which the operator carries parcels for different carrier customers; this makes a difference in terms of logistics efficiency, high load factor, much shorter distance per parcel, much better performance in time and costs per parcel, when compared to a distribution system for a single client.

- **the use of the city centre depot as base for a fleet of electric vehicles**; this lowers emissions because it replaces polluting diesel trucks and vans with zero emission vehicles for all trips to the final recipients of the parcels, located in the most polluted areas of the city centre.

- **the use of diesel trucks at night** to bring the parcels to Central London during a low traffic, low emission time; this solution completely avoids the usual peak traffic time in the mornings on the congested arterial roads towards city centre.
Logistics distribution model, case 1

BEFORE starting using Gnewtcargo

AFTER starting using Gnewtcargo

Retail logistics: single-carrier deliveries

Key

- Diesel van round, peak
- Electric van round, peak
- Truck trip off-peak
### Logistics distribution model, case 1

#### Energy use analysis of the Client B demonstration with and without Gnewt Cargo

<table>
<thead>
<tr>
<th></th>
<th>Without Gnewt: Diesel van</th>
<th>With Gnewt: Diesel truck</th>
<th>Without Gnewt: Nissan eNV200</th>
<th>With Gnewt: Total</th>
<th>Without-With reduction %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance</strong></td>
<td>km</td>
<td>16436</td>
<td>595</td>
<td>14054</td>
<td>14649</td>
</tr>
<tr>
<td><strong>Electric energy used</strong></td>
<td>kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conversion factor</strong></td>
<td>goe/kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total period</strong></td>
<td>litres</td>
<td>1479</td>
<td>112</td>
<td>112</td>
<td>92</td>
</tr>
<tr>
<td><strong>Conversion factor</strong></td>
<td>goe/litre</td>
<td>845</td>
<td>845</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total energy use</strong></td>
<td>kgoe</td>
<td>1250</td>
<td>95</td>
<td>213</td>
<td>307</td>
</tr>
<tr>
<td><strong>Results energy per km</strong></td>
<td>goe/km</td>
<td>76</td>
<td>159</td>
<td>31</td>
<td>90</td>
</tr>
<tr>
<td><strong>Results energy per parcel</strong></td>
<td>goe/parcel</td>
<td>97</td>
<td>7</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>
### Logistics distribution model, case 2

**BEFORE starting using Gnewtcargo**

- TNT Domestic Depot Northampton
- TNT International Depot Stansted
- TNT Depot Barking

**AFTER starting using Gnewtcargo**

- TNT Domestic Depot Northampton
- TNT International Depot Luton
- Gnewt depot West Central St.
- TNT depot Bermondsey

**Key**

- **Green Arrow**
  - Diesel van round, peak
  - Electric van round, peak
- **Blue Arrow**
  - Truck trip off-peak

**Distances**

<table>
<thead>
<tr>
<th></th>
<th>Miles</th>
<th>Km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average TNT delivery round per day <em>before</em></td>
<td>73</td>
<td>117</td>
</tr>
<tr>
<td>Average Gnewt Cargo delivery round per day <em>after</em></td>
<td>16</td>
<td>26</td>
</tr>
</tbody>
</table>
# Logistics distribution model, case 2
distance analysis

<table>
<thead>
<tr>
<th>April 2016</th>
<th>Parcel units</th>
<th>Miles</th>
<th>Km</th>
<th>Km/parcel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gnewt Cargo (TNT international) delivery journeys</strong></td>
<td>21,211</td>
<td>3,519</td>
<td>5,663</td>
<td></td>
</tr>
<tr>
<td><strong>Average Gnewt (TNT international) delivery distance</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.267</td>
</tr>
<tr>
<td><strong>Total TNT domestic deliveries</strong></td>
<td>30,089</td>
<td>15,315</td>
<td>24,647</td>
<td></td>
</tr>
<tr>
<td><strong>Average TNT domestic distance</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.820</td>
</tr>
<tr>
<td><strong>Difference in %</strong></td>
<td></td>
<td>77</td>
<td>77</td>
<td>67</td>
</tr>
</tbody>
</table>
Logistics distribution model, case 2
Overall analysis of efficiency & benefits

% reduction

- Reduction in the number of vehicle trips
- Reduction in total kilometres travelled
- Reduction in NOx (in g NOx/parcel)
- Reduction in PM (in g PM10/parcel)
- Reduction in CO2 emissions (in CO2e/parcel)
- Reduction in total transport energy use
- Reduction in empty vehicle distance

Achieved Q1 Target (final) Q1 (financial year 2016/2017)
Business & Citylogistics Efficiency
KPI: Metres per parcel delivered

1st July 2015 – 30 June 2016 (n = 13,358)

one point = average distance in metres per parcel for one delivery round =
one driver, one van, one full working day, 7 days/week, full day distance,
only paid (successful deliveries and collections) units counted

Potential for future efficiency improvements
Business & Citylogistics Efficiency

KPI: Completion rate

1st July 2015 – 30 June 2016 (n = 13,358)

one point = average distance in metres per parcel for one delivery round =
one driver, one van, one full working day, 7 days/week, full day distance,
only paid (successful deliveries and collections) units counted

% of successfully completed deliveries

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

0 2000 4000 6000 8000 10000 12000

Annual average 87%
Daily average trend line
ID of Delivery round

ID of Delivery round
Business & Citylogistics Efficiency
KPI: Working time per parcel

1st July 2015 – 30 June 2016 (n = 13,358)

one point = average distance in metres per parcel for one delivery round =
one driver, one van, one full working day, 7 days/week, full day distance,
only paid (successful deliveries and collections) units counted

Average 6 min. / parcel
Discussion

• Hypotheses verified?
• Questions answered?
• How other papers compare?
Final re-considering of initial project hypothesis, questions & objectives

• Initial **hypothesis**: Is it possible to scale-up the carriers’ carrier business model to obtain a better efficiency of urban distribution?

  In theory yes

• **Objective** of this study was to verify/falsify this hypothesis and answer the **question**:
  - what could be the future upscaling of urban distribution centers and electric vehicle use?
  - Using one specialist carrier and a fully market oriented business approach
Concluding remarks

Résumé:

- **Trials:** different business models were tested, corresponding to the different types of potential future clients

- **Results:** On most cases tested the distance driven are shorter, the emissions reduced, the daytime traffic decreased, the overall time spent per parcel decrease

- **Limitations:**
  - In one example, it was possible to reduce tailpipe emissions to zero. Only the lifecycle emissions of electric vans production and road surface dust &PM emissions remain.
  - It remains a very difficult business environment for an independent subcontractor, and to increase the market share
How other papers compare?

• Overview, review & prospective papers were essential otherwise the trials would have been meaningless

• No literature on testing different clients and business models benefiting citylogistics efficiency with an approach of real business trial data?

• Findings of this research obtain a distance reduction between 11% and 67%

• Decision makers and modelling authors working with assumptions (such as Rizet et al 2014) find an increase in total distance and costs due to smaller capacity vehicles and additional loading/unloading activities
Approaches required in future

• Work together with research, industry and public authorities to:
  ➢ Find suitable, central consolidation centre locations at prices lower than the real estate market
  ➢ Further test different business models with different clients, different cities
  ➢ Introduce bigger electric vans and trucks
  ➢ Obtain good quality before-after data